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Editorial

LICHEN TROPICUS

THE article dealing with so-called Lichen Tropicus which appears in this number draws attention to a group of helminthic diseases which, particularly in tropical and sub-tropical countries, are in the aggregate of very considerable economic importance and cause a great deal of discomfort to domesticated animals and inconvenience to their owners.

Usually not fatal and confined to the integumentary tissues, the conditions seen in affected animals are the result of a deep-seated infestation by nematode parasites, the larvæ of which, under favourable conditions of temperature and humidity, develop in such numbers near the surface of various parts of the body as to cause extensive lesions of the skin and subcutaneous tissues; for example, the tumour-like ulcerating lesions of bursati, more superficial ulceration of the skin and subjacent tissues such as are seen in "hump sores" of cattle and the ulcerated conditions of the extremities which are prevalent in particular areas where humidity is high or the animals stand a great deal

in water; or dry, scaly lesions of large areas of the surface of the body such as are discussed in this article.

Itchiness, seasonal periodicity, and a marked tendency to recur in the same animals are common features of these conditions, and though they do not as a rule lead to early death or destruction, the discomfort, disfigurement and disability caused by them is of sufficient importance to warrant more attention than has hitherto been given to the study of the life histories of the parasites concerned, and the discovery of more satisfactory methods of treating or controlling these very troublesome conditions.

The causative effect of the larvæ seems to be established, but no satisfactory method of medical or surgical treatment for the majority of these conditions has so far been discovered, and though their external manifestations tend to disappear each cool season they tend to become more severe with each recurrence.

From the very large number of synonyms which are employed to describe them it is clear that they attract a great deal of attention, and it is much to be desired that an exhaustive study should be made of these very disfiguring and disabling conditions.

General Articles

MICROFILARIAL PITYRIASIS IN EQUINES

(*Lichen tropicus*)

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In recent times considerable progress has been made in the study of diseases involving the human skin, particularly of the troublesome conditions peculiar to the tropics. Dermatology in the veterinary field, on the other hand, has remained a somewhat neglected subject and the pathology of quite a number of animal diseases is still enshrouded in mystery. Considerations of economic importance may be partly responsible for this state of affairs, but the role of the skin as a balancer of internal functions under varied environmental conditions is as yet only imperfectly understood. It is undoubted that morbidities of the cutaneous covering of animals do sometimes become very troublesome and interfere materially with normal animal husbandry. That the state of confusion is more serious than is usually believed will be clearly seen from a discussion of *Lichen tropicus* in this article.

The disease has been known in India for at least a century under the local names of *Khoojlee* and *Kharish,* meaning any skin disease characterised by scratching. It affects both horses and mules. Though the etiology remained obscure, the clinical picture of the disease was so precise, even to the lay mind, and its occurrence so frequent that such general terms as the " Indian skin disease of horses," " the usual," " familiar " or " common skin disease of India," came to be employed in veterinary literature. The disease has received scientific attention since the first studies of Grellier in 1843 and Queripel in 1879. It is a condition which does not respond to treatment but disappears mysteriously with the approach of winter, to reappear the following summer in the same erratic manner in special subjects to the exclusion of their neighbours. As such it has exercised the resources of veterinarians a great deal and numerous articles exist on the subject. For our purpose in this article it will suffice to recount the various names that have been employed by different investigators, firstly, to understand how different aspects of the same disease entity have impressed different observers, and,

secondly, in order that in places where similar terms are employed for designating obscure conditions, the data regarding Lichen tropicus recorded below may help in effecting elucidation. If one consults a standard veterinary treatise, such as Hutyra and Marek's Special Pathology and Therapeutics, one finds descriptions of conditions of unknown etiology under some of the names already used in India for Lichen tropicus, but presumably used in ignorance of the older Indian literature.

Lichen tropicus has been designated: Mange or itch (Grellier), eczema papulosum, prurigo (Queripel), psoriasis, "mane and tail disease" (Burke), impetigo contagiosa equi, summer mange, Indian ringworm (Edgar), Dhobie's itch, Tinea furfuracea (Haslam), seborrhœa sicca, pityriasis tropicalis, pityriasis sicca, dandruff, prickly heat (Meyrick), steatorrhœa sicca, cutaneous umbilicated crusts (Gunn, Lingard), irritable summer skin disease (Nesfield, 1907), and protein rash (Allen and Kingston, 1928). Besides the above multiplicity of names, Fleming confused the identity of this disease with summer sore as described by Rivolta, and du Toit in Mense's celebrated book on tropical diseases stated that cutaneous filariasis was included along with sporotrichosis and habronemiasis under the term Bursati in India. The disease has been likened to prickly heat and Dhobie's itch (Haslam) of human pathology, and the name Lichen tropicus has been used in recent publications as synonymous with prickly heat.

Geographical Distribution

The disease has been recorded from most provinces in India excepting some parts in the south, but the incidence is greater in some of the northern towns. The disease does not appear to be restricted to the Indian subcontinent; genuine cases have been encountered in the Sudan, Philippine Islands (Underwood, 1934), and perhaps in U.S.A. (Alicata, 1936). A similar condition has been reported from French West Africa (Aldigé), and from Greece (Papadaniel, 1936). Further, it is known that "bran and flour eczema" (pityriasis) occurs in Germany, and "Queensland mange" in Australia. There are strong reasons for believing that Lichen tropicus is even more widespread than the above records indicate.

Seasonal Incidence

The disease usually manifests itself in the early part of each hot weather, starting from March or April, and continues unchecked till the onset of the cold season in September or even much later. The skin of an affected animal may therefore remain free from any obvious disease for as many as four or five months in a year, but in well-established and long-standing cases the period of freedom may be almost obliterated. If an affected animal is transferred to the hills in the summer the disease retrogresses and may not reappear till the animal is returned to the plains.

Lichentropicus—Photo showing the predisposition sites of the disease.

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Clinical Symptoms

In the initial stages attention may be drawn to irregular patches of hair standing out abnormally, and on passing the hand over the affected areas, slight papular swellings of low elevation and up to the size of a sixpenny coin are detected. These to some extent resemble urticarial wheals, and may lead one to suspect bites of insects or mosquitoes. On parting the hair over the affected region a flattened and a somewhat burnished appearance is seen. If the surface epithelium only is excised and pressure applied, a minute quantity of clear serous fluid oozes out. The papular lesions are generally discrete and diffused throughout the superficial skin in the predisposition sites. The sides of the neck, the regions of the crest, shoulder, root of the tail, under-surface of the neck and abdomen are the sites affected. Neighbouring papules may become confluent. The intensity of the lesions, and the extent of the affected areas vary in different cases, and would appear to depend upon the interval that has elapsed since the first attack of the disease and the facilities for rubbing to which the animal has had access.

The hair over the affected region is peculiar in that it becomes unduly coarse, erect, crinkled and fragile, and some are grey. As the disease progresses, gradual shedding and breaking down of long hairs take place along with an increasing thinness of hair in irregular patches in various parts of the body. The depilation is readily noticeable in the region of the mane and the tail, and hence the name " mane and tail disease."

The most characteristic of all the symptoms is perhaps the copious and regular exfoliation of minute, white epithelial scales around each papule. Initially the scales are transparent, but with the exudation of serum or other fluids later the scales conglomerate into opaque masses. The amount of the serous exudation, which works its way to the surface, is so small that even after absorption by the cuticular and subjacent layers the scales appear dry. This explains why the word *sicca* has been used by earlier workers to qualify the designations—pityriasis, eczema or steatorrhœa.

The disease is further characterised by excessive irritation and itching, as a result of which the affected animal rubs violently and produces superficial abrasions or actual inflammation. The indications are that with the onset of the disease, the skin is rendered tender and predisposed to abrasion. The character of the inflammatory lesions depends upon the nature and duration of the injury and upon whether secondary complications supervene. The primary features may thus be masked, and the secondary changes become more prominent, leading to some difficulty in obtaining a clear understanding of the essential lesions. Prior to the breach of cuticular surface taking place, there may be only a minor degree of œdema in the texture of the skin, but as the surface becomes abraded there may be a continuous flow of moist exudation, including blood, accentuated by rubbing, thus fulfilling the requirements of the clinical picture of moist eczema.

One easily noticeable and differential feature of this disease is the distinctly superficial character of the lesion, i.e., without the involvement to any extent of the deep structures of the skin, as opposed to the more or less sharply defined tumours in cases of cutaneous granuloma of the type of Bursati or summer sore.

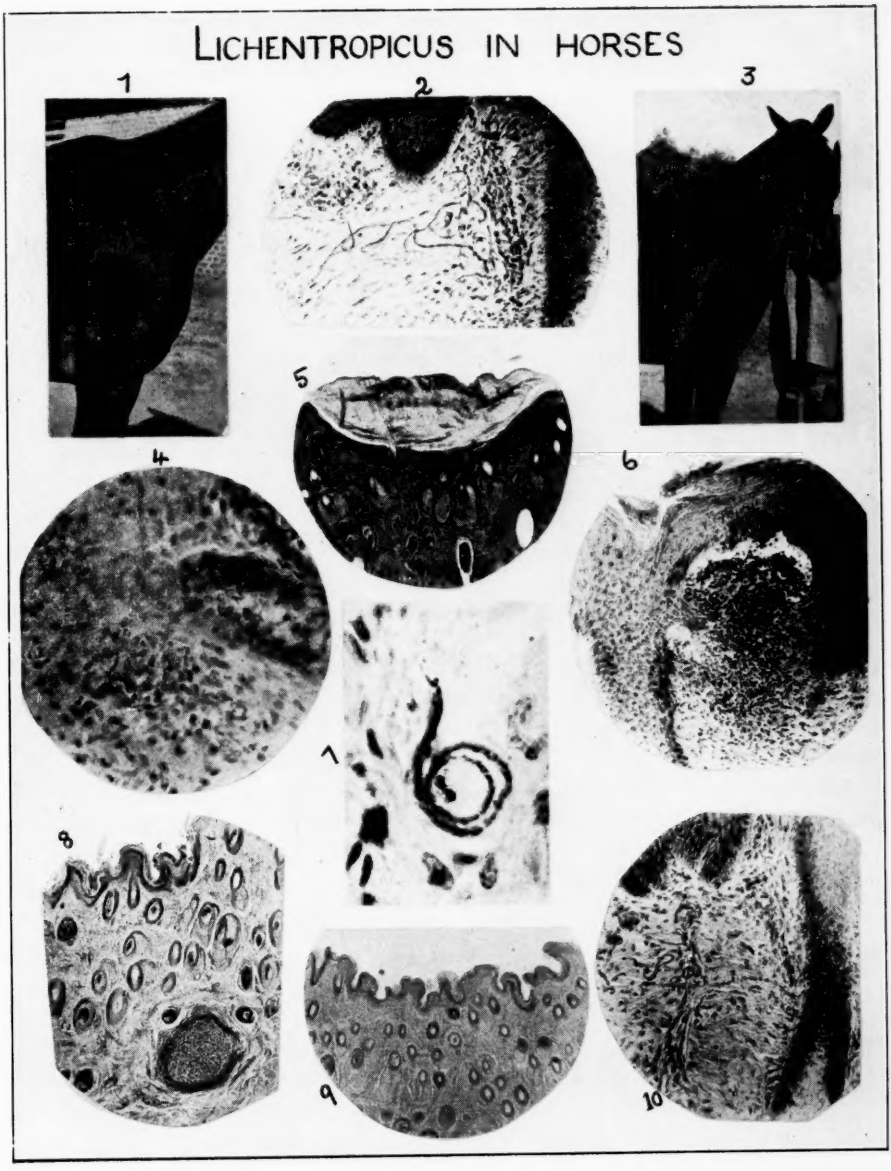
The general health of an affected subject is not seriously interfered with, though in some cases lack of rest, due to prolonged irritation, may produce considerable loss of bodily condition. A stage of pyrexia has not been observed, but a slight rise in the superficial temperature seems possible. In an affected subject, recurrence of lesions in successive years is the rule, and from their history one can safely indicate the horses in a battery or regiment that will develop symptoms during the approaching hot weather. All breeds of horses may develop the disease, but as a rule imported Australians appear to be highly predisposed. The disease is not contagious and *syces* and grooms attending clinical cases have never been observed to contract the disease.

Although the eruptions of Lichen tropicus are at first summer troubles only, predisposition seems to increase in the course of time. The subacutely inflamed skin becomes the seat of some permanent induration and sclerosis due to excoriation, which allows the disease to be more readily established in an affected subject than in earlier years. After a time the affected skin becomes thickened and greatly corrugated, particularly in the neck, crest and tail. The folds are disposed perpendicularly to the crest of the withers. When extensive depilation has taken place the tail presents a burnished wrinkled appearance, and the term " rat's tail " has been used to describe this appearance.

Etiology and Pathological Histology

The great variety of names under which the disease has been dealt with by various investigators has already been noticed. Different features of the disease have been emphasised to varying extents. Among the widely divergent views regarding its etiology, only the more common ones will be referred to here.

It has been ascribed to constitutional causes due to diet, climate, non-hygienic conditions, renal, hepatic or splenic disorder. It has been considered " as a cutaneous furor to which horses pampered and little worked are liable." The fiery heat of the plains of India has been incriminated as the exciting cause. Again, it has been ascribed to diet rather than to the climate, being attributable to long-continued and inordinate use of green fodder. The finding of various fungal organisms in the epidermal scales and scurf has been recorded by several authors, but the disease could not be set up experimentally, and yet certain authorities have gone so far as to consider that the disease is a form of ringworm—Dhobie's itch. Others showed how it differed in its course, pathological results and clinical aspects from ringworm infections.



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Tryon in Australia and Nesfield in India described sporiform bodies, and the latter admitted that they were often found on an apparently healthy surface and might possibly be nothing more than secondary infection on an eczematous surface, though personally he was not of that opinion. Gunn (1884) examined scabs from clinical cases after they had been variously treated with water, glycerine, potash, etc., and claimed to have discovered an animal parasite, resembling a tænia, and possessing a truncate caudal extremity and twenty cephalic processes or borers. Gunn's description of the parasite has been dismissed by Neumann and Lingard as vague. Skin scrapings have been examined by several workers (including Shaw, 1932, and the present writer), but no worms have ever been detected.

Queripel's view was that the fiery heat of the plains was the exciting cause, and Burke found that the hottest stations were those in which the largest number of cases occurred. The theory that the disease is essentially an allergic disease, being probably mainly brought about by the absorption of unchanged proteins from the ingested food material or by toxic bases resulting from the special types of organisms inhabiting the alimentary tract was advanced by Allen and Kingston in 1928. Shaw in 1932 enumerated all the suggested factors and argued very sensibly: "If any of these are really the cause, it should surely follow that where the rations, the amount of exercise and grooming are the same, all the animals of the unit ought to be affected. But, as this is not so, there must be other causes not yet fathomed. There undoubtedly is individual idiosyncrasy, as evidenced by the appearance of the disease in the same animals year after year, as well as colour susceptibility, the disease being met with chiefly among blacks and browns." More recently Holness (1933) states, "the causal and predisposing factors of Lichen tropicus are difficult, if not impossible of demonstration."

A perusal of the existing voluminous literature on the disease shows that no serious attempt has been made to study its histo-pathology. This lack of information can perhaps be explained on histological grounds alone, because the structural changes must appear to be only a comparatively slight response, compared with what one would expect to find in a disease-entity which *has* become so well established in the animal's system as the present one with its intractibility to treatment and recurrence in the same subject year after year. The microscopic features of this disease are, however, quite definite and precise, though the tissue reaction exhibited may appear unusual, in view of the more marked lesions in other diseases.

In the Annual Reports of the Imperial Veterinary Research Institute, Mukteswar, for the years 1931-32 (p. 19) and 1932-33 (p. 16), comments were made on the remarkable resemblance of the histological features of the lesions of the equine disease to those of *Craw-Craw*, a form of microfilarial itch of man of the West Coast of Africa, a fact which was suggestive of a similar

etiology. This expectation was fully confirmed before the 21st session of the Indian Science Congress, held in Bombay in January, 1934 (Datta, 1934). Pieces of the skin were received from 20 cases, preserved in normal saline and also in formalin, together with skin scrapings and blood smears made during the day and night. The blood smears and skin scrapings were invariably negative for microfilaria, but in hæmatoxylin-eosin stained sections of the skin constant association of microfilaria with an eosinophile infiltration was seen in all cases. Thin sections had to be cut, completely dehydrated before mounting, and with experience the microfilaria could be detected with a $\frac{2}{3}$ objective and No. 5 ocular, the suspicions being finally confirmed with the $\frac{1}{6}$ objective.

The main centre of the activities of the worm appear to be in the upper layer of the corium and in the papillary body, including the superficial cuticular layer of the epidermis and the hair and hair follicles. In the earliest stage, when no alterations or degenerations of the epidermal scales are manifest, there exists a definite dilatation and engorgement of the blood vessels immediately subjacent to the surface epithelium. Varying degrees of serous effusion with a sprinkling of leucocytes may be seen with the tissue and lymph spaces dilated. Around the blood vessel supplying the papillary body and in the dilated lymphatics, a marked cellular reaction is present and numbers of wriggling microfilaria may be seen. The most noteworthy infiltrating cells are the eosinophiles, the density and location of which, on closer examination, is helpful in the finding of the larvæ. The cellular reaction appears to be more marked up to that depth of the skin to which the hair follicles and the tubules of the cutaneous gland extend. In the active stages the cellular reaction extends considerably, and if the tissue has been chosen carefully the parasites are found in large number. Sometimes fresh pieces of skin may be placed on removal in normal saline and incubated, when the parasites congregate together in the papillary body or migrate into the saline solution. In the case of the partially quiescent lesions, collected late in the season, the finding of rare microfilaria requires considerable perseverance and care. Experience shows that in such cases a sufficient number of sections must be examined to obtain a positive diagnosis. The production of active lesions is connected with the richness of the parasitic infestation. Cuticular cells, some detached, others semi-detached, are seen, indicative of the process of exfoliation. The epidermis presents umbilicated depressions packed with cuticular cells. The hair and its follicles appear shrivelled, uneven, the cortical scales of the hairs detached or broken, the medulla of the hair constricted or discontinuous. In old-standing lesions considerable fibrosis, thickening and the formation of rugæ take place, and the papillary bodies appear greatly compressed from side to side. Blood vessels show degrees of endarteritis obliterans. The stratum germinativum shows proliferation of cells. The lesions are suggestive of the existence of a potent filarial toxin.

The Parasite

Several methods of examination have been employed, and repeated searches for adult worms made in specimens of fresh and preserved skin from the affected regions. With the exception of the nuchal ligaments (region of the mane) of several cases, which revealed the presence of *Onchocerca cervicalis,* a species not previously recorded in India, no adults have been detected. The finding is certainly suggestive, but difficulties exist in accepting *O. cervicalis* as the parents of the microfilaria concerned. The detailed morphology of the larvæ has been examined by helminthologists at Mukteswar, and one of them has recorded certain particulars (Srivastava, 1938), but as the existing information on the morphology of the larvæ of filarid worms is meagre and the life-history of the majority of Onchocercoid worms unknown, specific determination of the microfilaria must await a future date. It is important, however, to record as many details as possible of the microfilaria:

The photomicrographs illustrating this article show how the microfilaria are situated in the papillary body and how in sections they lie irregularly in serpentine forms and graceful coils.

The microfilaria is not provided with any sheath. The average length is 185 microns, and the maximum thickness attained slightly posterior to the cephalic extremity is 3.5 microns. The head end is bluntly rounded and does not bear any armature. The cephalic spot, which is a clear area, extends for a distance of 3.5 microns from the anterior end. Immediately behind the spot there are two large oval cephalic cells, placed one behind the other. The nerve ring is situated obliquely at a distance of 43 microns from the anterior extremity. It is 3 microns in breadth, The excretory pore is situated at a distance of 3 microns, posterior to the nerve ring, and the excretory cell, which is irregularly oval, is situated 14 microns from it. There are four chief genital cells, the last two of which are situated at a distance of 17 and 18 microns from the tip of the tail. The second genital cell is 10 microns anterior to the third one, and the first one is situated 14 microns in front of the third. All the genital cells excepting the first are round. The first genital cell is oval and has a large granular nucleus. The chief characteristic of the microfilaria of Lichen tropicus appears to be the presence of two large cephalic cells, according to Bhalerao, and this may be of some value in specific differentiation. It is certain that this microfilaria has no structural resemblance to the so-called tænia described by Gunn, and the possibility of one being the developmental stage of the other is extremely remote.

Recently particulars regarding forms of skin disease of microfilarial origin, bearing a close resemblance to Lichen tropicus of India or identical with it, have been recorded from countries outside the Indian sub-continent, but the morphological details of the microfilaria are so brief as to render futile any attempt at comparison of the parasites, as described from the different

countries. Underwood's (1934) material (56 cases) relates to Philippine Islands and Texas, Alicata (1936) deals with two cases from America, and Papadaniel with material from Greece. Underwood calls the disease "equine dhobie itch," and it may be of interest to ascertain how this old and purely Indian name comes to be employed there.

It is important to note that as in India so also in these countries, the microfilaria of the skin disease are suspected to be the larvæ of *Onchocerca cervicalis,* which occurs in the ligamentum nuchæ of equines. *O. cervicalis* occurs in many countries, associated sometimes with cases of poll evil and fistulous withers, and sometimes in apparently healthy horses. How far are these facts in harmony with each other?

As far as India is concerned, poll evil and fistulous withers appear to be very rare and so far *O. cervicalis* has not been detected in any horse failing to produce evidence of attacks of Lichen tropicus.

Treatment

Numerous skin dressings and internal remedies have been used in the past without success. Subcutaneous injections of spleen extract have been given an extensive trial, but the results have been erratic. In the light of the causative parasite being shown to be the larvæ of a nematode, the injection of antimosan into the affected sites has been recommended by the present writer as the best procedure to adopt. Novarsenobenzol by injections subcutaneously would seem to be equally promising. Novarsenobenzol may sometimes be used locally as an ointment. Daly (1939) treated cases of Lichen tropicus and records some beneficial results from the intravenous administration of antimosan. It has been pointed out (Datta, 1936) that since the parasite has not been detected in the blood stream, intravenous administration of antimosan would appear to be irrational and circuitous. Local applications of fly repellents and emollient soothing salves are generally helpful in reducing irritation. Prevention must depend upon the knowledge of any blood-sucking arthropod that may be found to be implicated.

Discussion

The chance association of microfilariasis with other diseases has been discussed by Macalister (1917) in his Memoir on Kumri. The literature on equine microfilariasis was critically reviewed by Sen (1931), who gained the impression that the clinical symptoms attributed to microfilarial invasion might have been due to causes other than microfilariasis and that microfilariasis of the horse was not associated with any clear clinical picture.

The establishment of a definite microfilarial disease entity—a common skin disease characterised by its seasonal incidence, non-contagiousness, recurrence, chronic, papular, scurfy and severe irritable nature—is therefore of more than ordinary interest.

O. cervicalis occurs in tropical and temperate countries, including England.

Horses suffering from Lichen tropicus have been observed to have periods of freedom from the disease during the winter or when moved to the hills. In the acute stage of the disease, microfilarial infestation in the skin is heavy, while in the quiescent stages microfilaria are rare. The "fiery heat" of the summer appears to determine the richness of the microfilarial infestion, whether due to a larger number of infective larvæ being injected during the season by blood-sucking arthropods, or due to an abnormality in the condition of the lymphatics and capillaries draining the skin. The predisposition in blacks and browns appears to depend upon the absorption of heat rays by those colours.

O. cervicalis of the ligamentum nuchæ is considered by some helminthologists to be synonymous with *O. reticulata,* which occurs in the suspensory ligaments of the fetlock and the flexor tendons, but the pathological data available regarding the two species make this view somewhat anomalous.

Do cases of Lichen tropicus occur in Europe, being latent most of the time, similar to that in India during the winter or in the hills? Do any appreciable percentage of healthy horses harbour the parasite in the nuchal ligament without any obvious detriment? What is the significance of the parasite when encountered in cases of poll evil and fistulous withers?

Describing pityriasis in Germany, Roll stated that the disease attacks the horse principally on the head and sides of the neck, along the course of the mane and roof of the tail, but occasionally all over the body. Semmer, working in the same country, found numerous nematodes between the derma and epiderma in a horse affected with dermatosis, which was considered to be psoriasis. Baruchello, presumably in Italy, observed filariasis among cavalry horses, involving the withers, neck, forelock and base of the tail, and described dark grey tumours up to the size of a pigeon's egg and agamous nematodes therein, but it is not clear whether this report is comparable with the experience in India.

Regarding differential diagnosis, Darmagnac in France encountered dourine-like swellings in horses as a result of filarial infestation, and Pease in India described a similar disease. The chronic scurfy and irritable nature of Lichen tropicus was not present in these cases, and they must have been different from it. Cases of summer hæmorrhage, due to *Parafilaria multi-papillosa,* characterised by the appearance of nodules each day followed by healing the following day, occur in India. Further, it is necessary to know that a form of recurrent ophthalmia due to unsheathed microfilaria occurs in young horses in certain stud farms in North India, resembling ophthalmia (associated with Guatemala nodules) of man due to *Onchocerca sp.* Besides this, *Thelazia lachrymalis* and larvæ of *Setaria equina* (*filaria oculi*) occur in the eyes of horses. To avoid confusion, these facts must be known.

Lastly, regarding the name Lichen tropicus, Allen and Kingston (1928) have rightly pointed out that prickly heat, in common with numerous other

appellations, conveys very little by way of etiological implication, and suggest the name "protein rash." The word "Lichen" has been employed since the days of Hippocrates (460-377 B.C.) for papular eruptive diseases which spread on the skin, resembling to a certain extent the growth of cryptogamic lichens on trees and stones, but we owe the first precise definition of the term to the celebrated Scotch dermatologist Robert Wilan (1757-1812), as an extensive eruption of papules affecting adults, which was connected with internal disorder, usually terminating in scurf, was recurrent and not contagious. This fits in with the clinical picture of the equine disease, but since the term is inclined to prolong the existence of the idea of similarity of this condition in equines with either members of the vegetable kingdom or with human conditions of unlike etiology, a more satisfactory name should be adopted in the future. From the differential standpoint, *microfilarial* (or filarial) *pityriasis* would appear to be a most appropriate designation for all future use.

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NORMAL BLOOD CELLS IN THE BOVINE*

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RED BLOOD CORPUSCLES

Literature

THE average size of the red blood corpuscle in bovines is given as approximately 5.3u, and although Fraser, Kohanawa and Berthe carefully indicate that considerable variation in size may occur, others fail to suggest that

*Part of a thesis presented by the writer to the Edinburgh University, November, 1938, for the degree of Doctor of Philosophy.

anisocytosis is a possible feature to be found during an examination of normal cattle blood.

Fraser (1930) states that supravital staining shows the presence of reticulocytes in some calves aged less than two days, but that after that age none are to be found. Using Giemsa, he demonstrated the phenomenon of punctate basiphilia in calves, but failed to find it in the blood of healthy calves after the age of 48 hours. Stippling was not noted in some calves, even when examined within two hours of birth. Fraser considers the bovine red blood corpuscle to be typically bi-concave, the centre of each corpuscle appearing paler than the periphery in stained specimens. He also points out that although the upper limit for normal red cells is probably 7.8u, a few occur whose diameter is greater—8.6-9.6u; of these, he remarks: " These were never found more frequently than one in many fields, and their staining properties resembled those of the other red blood corpuscles. They were not seen in increased quantities in any diseased cattle examined, and as nucleated forms were never observed, classification is difficult. As they appear to be a physiological occurrence, it seems most probable that they are merely macronormocytes, and have no relation to the large corpuscles of embryonal blood formation; but no evidence was obtained in support of either possibility."

Concerning normoblasts, whereas Kohanawa (1928) considers none present in adult cattle, Fraser states that they occur at all ages, more frequently in young calves, but even then they are not common.

Original Observations

In the present study of normal cattle, 40 animals have been examined, 14 of which were calves aged from one day to three months.

The average diameter of the red blood corpuscle was found to be 6.5u, which is rather higher than that usually recorded (5.3u), but this may have been due to the fact that coverslip preparations were used, where less shrinkage of cells is believed to occur compared with the using of ordinary smear preparations.

The striking feature noted was the degree of anisocytosis found in healthy cattle—calves and adults alike—so much so to quote an average figure for the measurement of typical corpuscles is rather misleading, for they vary from 4u to 8u. The majority of normocytes range from 5u to 7u, but both microcytes and macrocytes occur, and their appearance is typical of bovine blood.

Contrary to general experience, the writer has found that large numbers of normocytes display characters which are not indicative of their bi-concave formation. When stained, they show no depression of their centres and therefore the eosin tints they assume are such that each corpuscle appears an even pink throughout. In this connection, it is noteworthy that the largest red blood

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corpuscles are always fully hæmoglobiniferous, whereas the microcytes may be orthochromatic or hyperchromatic.

The quotation given from Fraser shows that he too has noted specially large corpuscles as a physiological feature in bovines, but he prefers to term them macro-normocytes rather than megalocytes, though he admits that no evidence was obtained in support of either possibility.

A study of Plate 17 dealing with *Erythroblastosis fœtalis* in the human (Piney and Wyard, 1938) shows similar features to that in bovine blood (although rather more exaggerated)—i.e., typical bi-concave corpuscles, and others both large and small hyperchromatic in appearance.

There is, therefore, a strong possibility that the cells in question are megalocytes, especially as they are more noticeable in the young than the adult bovine, although they are not oval as described by Davidson and Gullard in the case of megalocytes typical of pernicious anæmia. These writers also point out (p. 150) that " the appearance of the red corpuscles in a film varies somewhat according to the thickness. If the film be thin and evenly spread, the corpuscles generally are uniformly stained throughout. The central concavity or central pallor is not clearly seen as it is in normal blood, and still more so in anæmias of low colour index."

Another interesting feature in normal calves is that the blood platelets are frequently very large. Piney states that giant-platelets are characteristic of Werlhof's disease, whilst Davidson and Gullard note that individual platelets markedly increased in size may be a feature in severe cases of pernicious anæmia.

There is little doubt the whole question of erythropoiesis in the bovine requires careful investigation to decide:

(1) Whether the large red blood corpuscles are true megalocytes and of embryonal origin.

(2) Why numbers of corpuscles appear with no central depressions, and whether this is due to an artefact in preparation and staining, or associated with their shape, i.e., that they are not really bi-concave. There is perhaps reason to believe that such an investigation would be of value in the general study of hæmatology relative to pernicious anæmia.

Regenerative Changes

Unlike the blood of most other young mammals and also of chickens, apart from anisocytosis, there are few signs of regeneration in the new-born calf. There are few polychromasic normocytes, and normoblasts are rare. In an examination of the blood of six calves aged 4-40 hours, during the counting of 1,700 leucocytes, during which about one and a half million red corpuscles were encountered, only one normoblast was noted. These examinations did not disclose any cells with signs of punctate basiphilia, and only the finest

degrees of polychromasia were observed in a very small percentage of cells. This is confirmed by the finding of less than 1 per cent. reticulocytes in supravitally stained preparations for the youngest calves, and in confirmation of Fraser's work it should be pointed out that some calves even only 16 hours old show no reticulocytes. Only one other normal bovine showed erythroblasts and this, a five-day-old calf, in which six typically nucleated "cartwheel" normoblasts were noted during the making of a differential leucocyte count. The blood picture in general did not show any other features to indicate that this calf was other than healthy.

Neither poikilocytosis nor meniscocytosis were seen in normal bovine blood, but a few sickle cells were noted in a one-day-old calf—no such cells have been observed in any other animal—mammal or bird—and they may therefore have been due to artefacts in preparation, although their appearance was typical of the cells seen in Drepano-cythæmia (Piney and Wyard, 1938, Plate XIV).

Adult bovines show few features of note where erythrocytes are concerned for normocytes, punctate basiphilia, polychromasia (or reticulosis) and poikilocytosis are absent, but the anisocytosis of calves (noted above) is usually to be seen in cattle of all ages.

From these facts it will be appreciated that the normal bovine passes into its blood-stream only mature normocytes, therefore the erythropoietic system shows few features illustrating the adjustment of the young calf to its extra-uterine existence.

Blood Platelets

A casual examination of the blood platelets in cattle gives an impression that they are mauve-purple in colour. This is actually due to:

(1) A light blue background—the "cytoplasm," and

(2) A number of fine or large *dull* azur points—the granules, creating a general hazy mauve effect.

Contrasted with the platelets of man, in which the granules are bright azure in colour, these are much more dull and rather dirty in appearance. Also, except in the case of the giant platelets, they are always massed together to agglomerate into a large irregular cell-like mass. In the largest platelets, when seen singly, pseudopodia-like projections of the cytoplasm are common.

In some blood films the platelets will be noted to congregate near or around the polymorphs, but not the lymphocytes, presumably due to some chemiotactic factor associated with the former cells.

The Neutrophilic Granulocyte

The bovine polymorph is an interesting cell because of its nucleus, granules and cytoplasm.

The cytoplasm is apparently of an *acid* nature, for it exhibits marked

acidophile properties when stained in the usual panoptic manner—as for differential count purposes. As a result, the neutral granules tend to be obscured, and unless very great care is taken, large numbers of films will be prepared in which the neutrophiles are shown apparently free of granules. Even under optimum staining conditions they fail to stain with any intensity comparable with that of man, where the polymorph is a cell characterised by its granules. In the bovine, not only are the granules difficult to stain, but they are somewhat fewer in number and smaller in size than in most mammals —appearing as fine neutral or basic points of irregular size.

The average size of a bovine polymorph is about 11u to 12u, which confirms the measurement given by Fraser; but, as with the erythrocytes, there is considerable variation in size when large numbers are examined, ranging from about 10.5u to 14.5u.

The nucleus is both polymorphic and polylobular, but the latter feature is not as great as with sheep or in man, where the weighted mean in both cases is seen to be considerably higher than in cattle. Its many shapes are especially well seen in the various neutrophiles found in the Class I series; the older polymorphs following the recognised procedure of falling into stereotyped classes associated with an increase in nuclear lobes. This morphological complexity of the neutrophile nucleus is discussed under the heading of Modified Arneth Counts.

Using Pappenheim's panoptic staining method, the nucleus is seen to be a bright purple colour with lines of demarcation associated with pale oxychromatin. Early forms—metamyelocytes—are less intensely stained, giving a more openwork appearance, whilst the polylobular varieties show a deeper purple—more pyknotic—nucleus with little differentiation of the chromatin. Metamyelocytes are seen more frequently in calves in which up to 8 per cent. or 9 per cent. may be considered normal, whereas in adult bovines only 1 per cent. or 2 per cent. will be found; "Young" forms are rarer still—approximately .5 per cent. and .1 per cent. respectively. Fraser, Sokolov, Gudin-Lewhowitsch, Sergent and Haffner are all agreed as to the few "Bands" normally found in healthy cattle.

Hypersegmented polymorphs are not common, one five-lobed neutrophile having been noted only in a calf, and during the counting of 3,600 bovine leucocytes for "Arneth" purposes only 31 were found to be in Class IV.

A specific feature of the polymorph nucleus is its rope-like or corded silk appearance following the "band" stage and before true segmentation occurs. It elongates, but still fails to pass into Class II, because no second lobe to the nucleus has yet been formed. It appears as though the nucleus must continue to increase in length; therefore to remain accommodated within the cell it requires to bend over on itself or to assume other complex twisted positions.

Supravitally stained, the neutrophile shows no differential characters additional to those disclosed by the ordinary panoptic method.

Neutrophile myelocytes and earlier forms are never seen in bovine blood in health, and if these cells are noted in differential counts they are always clear evidence of stimulation of the bone marrow.

Eosinophile Leucocyte

The eosinophile is a round cell, larger in size than the neutrophile, being about 12.3u in diameter.

In supravitally stained blood films, the eosinophile granulocyte's characteristic appearance is second only in importance to that of the reticulocytes. The relatively large size of the granules and their refractile appearance are outstanding.

Eosinophiles are common in adult cattle, but only about .4 per cent. are to be found in calves. Their cytoplasm stains light blue, the granules are numerous, frequently overlying the nucleus, although the general conformation of the latter can usually be seen. Indented nuclei of the "band" and early Class I types are common, but "youngs" and myelocyte varieties are also seen in health in calves, as are those with two lobes to the nucleus. The tightly packed round granules of even size stain a brightish brick red or deep orange colour, but occasionally a few vacuolated areas in the cytoplasm may also be noted.

The nucleus is quite easily distinguished from that of the polymorph, assuming royal blue and pale eosin shades with the oxy- and basi-chromatin thus clearly differentiated. It should be noted that the Class I nucleus never elongates like that of the neutrophile, but quickly passes to become bi-lobed.

In cows, where the percentage of eosinophiles may reach up to 23 per cent. in health, "band" forms are again prominent, but segmented types up to Class III may be seen.

In the opinion of the writer, accurate classification of the eosinophiles in terms of the Polylobular or Schilling Counts is impracticable, but Fraser has recorded the following for healthy cattle:

Class I	*"Bands"*	*Class II*	*Class III*
83.2	43.2	15.7	1.1

The Basiphile Granulocyte

This cell is about the same size as the neutrophile, and therefore usually smaller than the eosinophile—i.e., about 11.3u.

The cytoplasm is not usually seen, owing to the space occupied by the nucleus and granules, but occasionally a small portion of it may be noted as a pale blue rim to the cell. The nucleus also takes on the basic stains, and in contrast to the other granulocytes its colour is blue rather than purple. Its shape frequently appears distorted, due to the numerous granules, but

it is often monolobular and indented—on few occasions only has the writer seen a basiphile from a healthy bovine with a nucleus comparable with that described by Fraser, "the nucleus in most cells (basophiles) appeared to be highly lobulated, the lobes being closely applied to one another, so that the nucleus resembled a bunch of six to ten grapes."

This writer also described two types of basiphile granules, but no such clear-cut definition appears possible because they frequently run together and therefore appear to have "fused" like particles of mercury. This feature is even more clearly seen in the basiphiles of the domestic hen. The granules of the bovine basiphile are small, numerous and deep purple in colour; but at the periphery of the cell, where the concentration of granules is less than elsewhere, they appear bright azur.

In the examination of 500 leucocytes, whereas two eosinophiles are seen in calves there are usually three basiphiles, but no greater number is found even in adult bovines, where the percentage still remains about .6 per cent., to contrast markedly with that of the eosinophiles (up to 25 per cent.).

The Lymphocytes

The lymphocytes of the ox vary greatly in size from about 7.9u to 13.7u, averaging 10.4u, and although there are cells of all sizes to be found between these upper and lower limits it is convenient to sub-divide the lymphocytes into three groups—large, medium and small varieties. This is purely an arbitrary division, but nevertheless useful from both a clinical and genetic standpoint.

The following characters are common to all lymphocytes: The cell is round, the cytoplasm is pale blue, devoid of true granules, and the purple nucleus is "blobby" in appearance, i.e., the basi-chromatin appears as "hillocks" among the lighter oxy-chromatic "dales" which show no organised distribution throughout the nucleus.

Specific variations are as follows:

The Large Lymphocyte

The average diameter is about 12u to 14u; its cytoplasm may appear (a) pale blue, (b) polychromasic, due to the presence of innumerable fine pale eosin tinted areas intermingling with the ordinary basic cytoplasm, or (c) Türk-type—i.e., deeper, navy blue coloured; occasionally only the periphery of the cell is deeply stained. Such latter "Lympho-Türk" cells (large variety) are common in the adult bovine, but absent in the calf. Vacuolated large lymphocytes are also rare in the calf, but of common occurrence in the cow. This is contrary to the experience of Fraser, who has found "nothing in the nature of vacuoles in healthy cattle."

The cytoplasm may contain fine azur granules, but these are not as common as large lymphocytes with deeply basic cytoplasm, nor are they seen in calves.

Owing to the ill-defined character of the nucleus in large numbers of cells there is often very great difficulty in distinguishing some large lymphocytes from small monocytes. The typical "blobby" appearance is much less well defined than in man, many other mammals or chickens. Its shape is typically oval, but kidney-shaped varieties are common, and a few with a fully cleft nucleus are also seen. Such Reider cells have not been noted in the calf.

Large lymphocytes are predominant in bulls and yearling cattle, and they are also noteworthy in the differential count of calves, but in heifers, milking cows and bullocks the percentage is low.

The Medium Lymphocyte

In the normal maturation of the large lymphocyte the nucleus and cytoplasm both undergo condensation with an associated reduction in size, thus forming one variety of medium sized lymphocyte. On the other hand, if a young large lymphocyte undergoes mitotic division this will also form two medium sized lymphocytes. The Reider cells noted above confirm that nuclear division presumably preparatory to that of the cell is not an uncommon feature in the large lymphocyte.

In the making of a differential count any lymphocyte not typically large or small is obviously one of medium size, but for practical purposes the following definitions for lymphocyte groups have been used:

(1) The small lymphocyte is only just larger than the typical red blood corpuscle, with scanty cytoplasm and pyknotic nucleus.

(2) The large lymphocyte is larger than the polymorph or basiphile.

(3) The remainder are medium sized lymphocytes.

Admittedly, the classification is not an accurate one, but it is surprising how easy it becomes to group the lymphocytes satisfactorily. Further, it is a particularly good method to show the relationship between the definitely large and typically small lymphocytes.

The average size of the medium lymphocyte is about 10.5u, but the probable range is from 9u to 11.5u. A typical cell is therefore rather less in size than a polymorph, and in a few cases azur granules are common, though in the adult bovine azur masses are also seen. Medium sized lymphotürk cells are more common in the calf than in the cow—the reverse, in fact, of the large variety. On rare occasions the nucleus will be cleft, but this is probably a small large lymphocyte rather than a true medium lymphocyte undergoing mitosis.

The nucleus is normally slightly oval, but a few show side indentations—leading to kidney type nuclei. Fraser confirms that bi-lobed forms (Reider-type) of lymphocytes do occur in cattle and that they are always found in cells of medium or large size.

In a few cattle, notably calves, the nuclear morphology has been charac-

terised by three or four large plasmosomes and in the same animals these have been present in all varieties of lymphocytes.

Medium sized lymphocytes predominate in calves, heifers and cows.

The Small Lymphocyte

The smallest non-granular leucocyte has a diameter little more than that of the red corpuscle, ranging from about 7.9u to 8.9u. The cytoplasm is never more than a narrow rim around the nucleus, though rarely as scanty as in the chicken. If azur masses or granules are present, they often completely hide the cytoplasm. The nucleus is pyknotic and therefore deep purple in colour, and with little or no oxy-chromatin visible. Small lymphocytes predominate in the bull.

In general, the smaller the lymphocyte the less cytoplasm will it possess, although in comparison with the domestic hen the large lymphocyte of the cow possesses proportionately much more nucleus. A change concomitant with the reduction in size of the cell is seen in the nucleus, the basi-chromatin of which condenses to the exclusion of the lighter oxy-chromatin. These are the typical changes of age, and confirm the belief that the large lymphocyte is the direct descendant of the lymphoblast and the precursor of the small lymphocyte.

The percentage distribution of the different classes of lymphocytes in cattle are as follows:

	Per cent. L.L.	*Per cent.* M.L.	*Per cent.* S.L.
Calves	27 ...	42 ...	31
Yearlings	41 ...	42 ...	17
Heifers	16 ...	45 ...	39
Cows	18 ...	55 ...	27
Bullocks	9 ...	44 ...	47
Bulls	81 ...	15 ...	4

The Monocyte

As indicated in the section dealing with large lymphocytes, there is often confusion between these cells and the monocytes, even though the latter are described typically as the largest of the circulating hyaline leucocytes.

The largest mononuclears average about 16.5u, but small ones practically indistinguishable from the lymphocytes are only 13u in diameter, whereas the largest monocytes measure 18u to 19u. The total area of an average monocyte is about six times that of an erythrocyte.

The cytoplasm of this round or oval cell is not typically pale blue as in numbers of the lymphocytes, but it has a pale, slate or polychromasic appearance, due to eosinophilic areas being scattered throughout the pale royal blue cytoplasm. Sometimes the whole effect is altered owing to the cell having

a greater affinity for basic stains than normal, so that a Türk-type of monocyte develops. The deep blue cytoplasm may only be limited to the periphery of the cell.

Azur masses have not been seen in any monocyte from healthy bovines, but fine azur granules are sometimes seen usually close to the main nuclear indentation in monocytes with bean or kidney shaped nuclei.

The nucleus has no constant shape, although the so-called transitional leucocytes of Ehrlich are commonest among the bovine monocytes, but a few have oval or rounded nuclei. An analysis of 100 monocytes showed 60 per cent. to be typical transitional leucocytes. In the adult bovine, a few monocytes have been noted with the nucleus having undergone division similar to that in other non-granular Reider cells, but none were noted in calves.

Vacuolated monocytes are rare, a few having been seen in the calf; nor are nucleoli common, and these too have only been seen in the calf. No Kurloff bodies occur in bovine monocytes.

The general character of the nucleus contrasts sharply with that of a typical lymphocyte, for the basi-chromatin is arranged in fine strands, often at right angles to one another, giving the whole nucleus a linear appearance. Unfortunately, the "hillocky" appearance of the largest lymphocytes becomes indistinct, and therefore considerable confusion may arise in the differentiation of the two cells. The monocyte is described best as having little nuclear character in comparison with the lymphocyte, and therefore the purple tints it assumes are much more pale, giving it an anæmic appearance.

Monocytes are not common in the bovine, an average of 3 per cent. in all types of cattle having been recorded.

DIGESTIVE DERANGEMENT IN THE DOG AND CAT

By E. MIDDLETON PERRY, C.B.E., F.R.C.V.S., and C. H. PERRY, M.R.C.V.S.

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Of all conditions in the dog with which the veterinary surgeon is required to deal, it is conceivable that the digestive mechanism is responsible for the greater part. Fortunately, the symptoms are usually tell-tale and the disease thus easy to diagnose; but there remains yet one other condition which presents a disconcerting pathological picture. It is dyspepsia.

Although, to our knowledge at least, no report has been made of this condition as incident in the dog, we have had during the past year several cases, of which three will here be considered, and one of a comparable digestive derangement in the cat which, though probably isolated and unique, affected not the glands of the stomach but the pancreas.

XUM

In the dog, age, breed, sex, appear to have no bearing. This is plausible, the mechanism if not the efficiency of the stomach is identical in all dogs.

Pepsin, derived from its precursor pepsinogen, secreted by the fundus glands of the stomach, comprises 1.71 per cent. of a total analysis of gastric juice. Of the remainder, 97.3 per cent. is water; leaving 0.99 per cent. to be composed of eight other constituents here irrelevant. Pepsin therefore is of enormous importance; it splits protein into its further metabolic products of peptone and proteose, but, in common with other enzymes, is merely a catalyst and hence, inexhaustible; for in the acid medium of the stomach it enables metabolic changes to take place and, given time and the removal of the products of its action, will reduce an unlimited amount of its substrate (protein). Similarly trypsin : Poured out by the pancreas it is a constituent of succus entericus, and itself can break protein—but more rapidly than pepsin and into products further advanced (polypeptides). But it acts in an alkaline medium.

It is usually counted easy to be wise, afterwards. The discovery, however, by a process of elimination, that lack of pepsin was responsible for these dogs' illness, is still interesting when the case of the cat, suffering lack of trypsin or erepsin, is considered.

In the dyspeptic cases all symptoms were, naturally, comparable. But there were only three : lack of appetite, albuminuria, and great debility. Under the circumstances, nephritis was thought at first to be the cause, although the amount of albumen detected in the urine test was deemed insufficient to account for the patient's advanced condition. This deduction proved correct on two counts : by exploratory laparotomy, performed on the first patient, a six-year-old bulldog bitch, with a kidney palpably enlarged and possibly neoplastic, but which proved normal except in size. (The bitch, making an uneventful recovery from the operation, died later, presumably from starvation despite forced feeding.) And on the second count, in the light of our later success in treating a four-year-old dalmatian dog, from whose urine albumen, first demonstrated, entirely cleared on subsequent analysis.

If not nephritis, what then was the cause of this albuminuria? The only reference we can find is to "peptonurea," noticeable occasionally in certain pathological conditions, more particularly those associated with the disintegration of pus cells. This, as such, was unlikely, there was no infective focus; but it seems perhaps possible that a co-related process ensues during the breakdown of reserves of body tissues during starvation.

For these animals were, virtually, starving themselves, with one symptom here to bear out the obvious—a slight rise in temperature (103) covering a few days during the fourth week of illness (dalmatian and bulldog), followed by a fall (to 99.7). Apart from this, however, for starvation was an effect not a cause, there were still no symptoms save lack of appetite to enhance hope of diagnosis.

This admission of failure is not to suggest that pepsin was ignored before it eventually proved successful. It wasn't. But, administered in the form of tablets containing also bismuth carbonate and charcoal, its failure here seems only to indicate that the alkali content of these tablets neutralised the acidity of the stomach and deprived the pepsin of its congenial environment. Thus nothing happened. But it was noticed that change of medicine induced an appetite, for one meal only; due presumably to a sudden stimulation of the fundus glands of the stomach, which stimulation passed as the stomach became accustomed. Acid medicines had like effect, for one meal only. But acid alone, without pepsin, cannot digest.

It can, however, increase appetite, as can simply enough be demonstrated on an otherwise normal stomach. Also one is given to understand that one meal induces, after some hours, appetite for the next. This did not happen: one meal, though attended by quite normal digestion, no vomition, no discomfort, with even the passage, after a period, of normal fæces, led to no benefit. The dog, interested in the preparation of his food, would still refuse it. It takes perhaps five to six weeks to die of starvation. These animals, with forced feeding certainly, had been ill for four to five weeks.

Of the third dog, a wire fox-terrier six years old, we have unfortunately less information, it came to us for a second opinion prior to destruction on a diagnosis of "typhus" (Stuttgart?) infection. That it is still alive is due to the atypical syndrome, for there was no vomiting, no excessive thirst, no diarrhœa. But there was a brown tongue, subnormal temperature, inelasticity of the skin and that cadaverous smell associated with Stuttgart. Two grains of pepsin were given twice daily, and it started feeding.

Even so, the foregoing explanations, though possible, are somewhat more interesting when the cat is considered. For fifteen months, the owner reported, it had had an enormous appetite but no advantage from it, for food immediately produced the excretion of liquid fæces, as if in fact it passed directly through the alimentary canal without vestige of absorption. The animal was extremely thin: urine and fæces had both been submitted by the owner for analysis, from which nothing diagnostic had been reported—no tubercle bacilli, no albuminuria, nor any sugar to demonstrate diabetes. Again, only the elimination of other possibilities suggested treatment, and trypsin was administered in the form of pancreatin (grs. i) in keratin-coated pills three times daily; until now, when the owner reports the cat to be fatter and to be passing more solid fæces than at any time during the past eight months.

But this occurrence of diarrhœa in the cat and quite normal bowel-movement in the dogs raises several points of interest. It appears that—

(1) Pepsin is connected, anyway in part, with appetite.

(2) Tryptic digestion can take the place of peptic digestion, but not vice versa. Here, obviously, the polypeptides produced by tryptic digestion

are eventually capable of absorption, on further digestion, but the peptones of peptic metabolism are excreted in liquid fæces, presumably undigested.

(3) Given appetite, pepsin is not essential to well-being but that trypsin is.

(4) Albumen can occur in urine without the presence of nephritis and without, so far as we could ascertain, the disintegration of pus cells.

(5) Complete lack of pepsin in the stomach of the dog can also occur, and, more importantly, be cured without continued administration of pepsin, beyond say a week or two, but that

(6) Tryptic digestion in the cat demands such protracted treatment.

Finally, as regards differential diagnosis, dyspepsia in certain respects bears resemblance to nephritis, " brown mouth " and " Stuttgart." All of these are, fortunately, typical within their limits, but when these limits admit of doubt, the administration of pepsin may possibly save life. The results are so quick as to be astonishing.

BRITISH GUIANA AND THE CATTLE INDUSTRY

By EDWARD MORGAN, F.R.C.V.S., D.V.H.
Venezuela

RECENTLY many discussions have taken place both inside and outside the House of Commons on the question of utilising British Guiana as an immigration or colonial centre for Jews and Gentiles. A few months ago a Commission, composed of Britishers and Americans, was sent out to investigate and report on the conditions therein.

Having resided for many years in Venezuela, a Republic which adjoins British Guiana, and where naturally the climatic conditions in many regions of both countries are similar, perhaps a few remarks bearing on my long experience with the cattle breeding industry in Venezuela and the methods adopted to overcome some of the greatest obstacles which interfere with this industry—such as tropical diseases, particularly amongst imported pedigree stock—might be of some value to young veterinary surgeons who may be asked to take charge of this particular industry in British Guiana in the near future. In this way the regret which Mr. Henry Ford expressed some time ago, that people who had graduated from the finest university of this world, called experience, lost so much of their learning on account of being too old to convert it into practical form, might be avoided by always endeavouring to hand down periodically such knowledge as we may have gained to the younger generation, so that they may benefit and enhance it.

Firstly, no one should attempt to import with the intention of breeding fine stock on an extensive scale, unless paddocks have been previously arranged and planted with suitable grass for grazing as well as for cutting

for stall feeding such animals, which have to be fed indoors not only whilst being acclimatised, but probably afterwards.

As is well known, the greatest enemy of the stock breeder in the tropics is the tick, not only on account of its natural habit of fattening on the blood of animals, but, more serious still, being the carrier of diseases such as pyroplasmosis and anaplasmosis from native cattle to the pure breds. The native cattle harbour the parasites in their blood, but under normal conditions these are immuned (salted) against tick fever, etc.

There is a tropical grass which is cultivated extensively in Venezuela both for its highly nutritive value in proteins and for its tick-resisting properties while in its green stage. This grass also resists other parasites such as the mosquito, as well as snakes. Indeed, during the last few years the writer has supplied the Government of Venezuela with considerable quantities of seed of this grass for planting around dwelling houses in the country so as to protect the inhabitants against the above-mentioned pests. This grass grows best on dry land, even on hilly slopes. It is useless to attempt cultivating it on low land where water stagnates. Not being a deep-rooted grass, it disappears on loose or watery lowland soil during the first rainy season. The seeds should be sown in quantities of about 8 lbs. to the acre on firm soil. It can also be transplanted, i.e., by the roots. The land should be cleaned and the seeds sown preferably at the commencement of the rainy season. Care should be taken not to cover the seeds with soil. Some people commit an error by putting the harrow over the seeds, with fatal results. This grass is said to have originated in Africa. It is called in Venezuela "Gordura" (fattening grass), also "Capim Melado," but the technical name is "Melinis Minutiflora." It can be used as pasturage (grazing) and for cutting green for stall feeding as well as for haymaking, when it gives a very high yield. Although being a drought-resisting grass, it has the disadvantage of not being able to resist fire. It needs exceptional care so as to avoid an outbreak of fire during the dry season, by means of a safety clearance around the paddock, as the grass burns with vigour due to the great percentage of oily material it contains. Unlike most other tropical grasses, it takes the best part of a year after the grass is burned, under the best care, before it recuperates to its normal state. This is the most suitable grass to feed imported cattle whilst they are being acclimatised. What is left over by the animals at feeding time can be utilised as bedding so as to avoid any other class of grass which contains ticks.

Next to proper pasturage comes suitable housing accommodation for the animals. This should contain plenty of floor and headroom space, good drainage and ventilation, cool roof, wire gauze so as to be bat and mosquito proof, good water supply, and eucalyptus trees amongst others should be planted around the building to give shade and protection against the mosquito and other pests and to reduce the temperature. The manure should be carted

directly from the building long distances away so as to avoid flies. Flies have been seen even depositing their eggs on a lime heap left near a cattle breeding station in the tropics. The buildings and their surroundings in the tropics should surpass the standard of cleanliness of even those certified for attested herds in Great Britain.

A cattle bath for dipping the native cattle is indispensable. The imported cattle are often sprayed instead of being immersed, as they are not so agile as the native cattle inside and around the swimming bath. The younger fine stock are often driven through the bath similar to the native cattle. It is disastrous to allow imported bulls to come into contact with native cattle in the yards unless the latter are kept free of ticks by bathing them at least once a fortnight in an arsenical solution such as Garrapaticida. One may take good care of imported bulls by keeping them free of ticks by spraying, etc., yet it is fatal to turn them amongst native cows, as is customary morning and evening in the yards, unless the cows are also kept free of ticks. One tick from such cows often proves fatal to a recently imported animal in spite of previous inoculation against tick fever, etc.

Salt should be supplied *ad lib.*, preferably as salt licks, for both imported and native cattle. Without salt and other minerals, animals in the tropics will drive tunnels in the ground in their search for minerals which are lacking in the food. Animals receiving sufficient salt do not harbour as many ticks as those deprived of this normal constituent of the blood.

In speaking of native cattle in South America, one implies the descendants of Spanish cattle imported from Spain when most of the vast continent was under Spanish rule. They are the same originally as the Texas longhorns. Fortunately, in the United States and the best parts of the Argentina and Uruguay this type of cattle has given way to a better class of imported stock, mainly British stock. This old Spanish breed of cattle still predominates in both Venezuela and British Guiana, as well as other republics of tropical America. Fortunately, during the last quarter of a century a good number of European cattle as well as the Indian zebu have been imported to these countries, with satisfactory results. Pure bred European cattle are unable to thrive as well as the native, or the zebus, in tropical America, except in regions where modern methods of cattle breeding are adopted, such as providing proper pasturage for the cattle and systematic dipping, etc.

It is advisable in the tropics, in order to get cattle adaptable to resist the conditions, to breed them for range purposes with a fraction of the zebu strain along with the European strain. In one of the southern regions of the U.S.A. a herd of cattle has been formed which we can now almost call an established breed, which is the result of crossing the zebu with the shorthorn cattle, and selecting from amongst this cross the best animals of similar type and colour, with the result that now this herd has become famous as suitable cattle for the tropics.

Clinical Articles

RUPTURE OF THE UTERUS OF THE COW

By RICHARD HUDSON, F.R.C.V.S.
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THE subject was a Lincoln red cow due at her fourth calving in three or four weeks.

She had been developing a very heavy abdomen for some time and was found in the field straining and passing small amounts of hard fæces.

The owner gave her 1 lb. magnesium sulphate and a few hours later 1 pint ol lini, without giving her any relief. Her abdomen appeared to get larger.

Symptoms

The patient looked like a case of uterine dropsy, but was very full and slightly resonant over the upper part of the left flank. Her pulse was very small and fast, extremities cold and nose dirty. She had a painful grunt when moved and food and drink were refused.

She looked like dying.

The owner wished me to tap her stomach, and thinking it might give her some relief, the trochar was inserted. About three bucketfuls of blood-stained fluid escaped through the tube which was left in position while fluid continued to flow.

The day following I found her more comfortable, but she died later in the day.

The post-mortem examination showed that her womb had ruptured and that large born calves had escaped. The hoofs were easily sloughed off, so they had evidently been dead several days.

SEPTICÆMIA

(An Error in Diagnosis)

DURING spring and early summer, when milk fever and lactation tetany are prevalent, one is apt to come to the conclusion that any prostrate cow is one or the other. There may be conditions and symptoms which raise a doubt, but all milk fever and tetany cases do not comply with textbook symptoms.

The cow in point had calved a fortnight before time, but had "sprung" in her udder and was a heavy milker.

She had been calved two days and had not cleaned. She was unconscious though the owner thought her all right the night before, excepting that she had retained her membranes and for which he had given her a drench.

Pulse and temperature do not tell you much in such a case, so thinking that she was more like a milk fever case than anything else, calcium chloride 1 ounce, magnesium chloride 3 drams, aquæ 24 ounces, was given intravenously and strychnine 1 gr. hypodermically. Seen about four hours later she was conscious and able to hold up her head; about three hours later she was dead.

The post-mortem examination showed acute septicæmia. At the far end of one horn of the uterus there was a hole about four inches long (perhaps a foot had penetrated), septic changes had developed in the membranes and septic fluids had escaped into the peritoneal cavity, setting up peritonitis and septicæmia.

Abstracts

CLINICAL STUDIES ON MASTITIS OF COWS*

By DR. H. CHARPHON

Mantes-sur-Seine, France

THE reader who consults modern works or who refers to the researches of laboratories would imagine that veterinarians are sufficiently well posted to diagnose and treat the different types of inflammation of the mammæ. The reality is, however, quite different, for in adhering to classical facts in the throng of cases encountered it has not been thought possible to determine whether given mastites are parenchymatous, interstitial or inflammation of the galactophorus ducts.

This ignorance is regrettable, as all practitioners will agree that the economic and medical prognosis is varied according to the extension and nature of the lesions. Moreover, a more exact understanding of each modality would perhaps suggest a more rational therapy. A more precise diagnosis would also be helpful to the laboratory research, as the studies lack uniformity of results. All inflammatory troubles are included. If the chemical study were supported by a more perfect understanding of the anatomical disorders, it would perhaps be possible to classify the facts noted and to discern rules which now escape attention.

For these reasons I have attempted for several years to determine if a simple and rapid examination of the mammæ, such as practitioners are obliged to make, might not be illuminating.

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*N. *Amer. Veterinarian,* February, 1931, translated from *Revue de Pathologie Comparé,* June, 1930.

Before exposing the results obtained, remarks on the terminology of mammary affections seem in order. We never employ the name catarrhal mastitis because it tends to confuse this affection with authentic mastites, although under certain circumstances this distinction seems as necessary as between bronchitis and pneumonia.

We therefore call inflammation of the lacteal ducts galactophoritis, and we reserve the word mastitis for the affection characterised by lesions of the glandular tissue, whether the origin is internal or external—that is, whether the infection comes from within or without.

In the series of cases ordinarily observed, pure mammitis is rarely encountered and likewise galactophoritis without extension to the parenchyma, except at the onset, is rare. This idea is classical.

From time to time one has the opportunity to follow up typical cases of these differential affections. Exceptional as such cases may be, they permit one to interpret the complex ones. Here are several observations:

Case 1.—Grave mastitis. Normand cow, 6 years old, calved 6 weeks before. One morning she had a chill and gave but little milk. Inappetence complete. In the afternoon the hyperthemia was marked. The two hind quarters were hard throughout without swelling either in the glands or teats. The skin over the indurated quarters was supple. Milking brought out a small quantity of liquid without clots. In every respect it was like serum. The secretion of these two glands scarcely filled a tumbler and a half per day. From the front quarters the milk was normal but scant. The milk remained completely serous from day to day and in 15 days the glands were entirely lost for lactation.

Case 2.—Benign mastitis. Normand cow, 5 years old. Hot vinegar was applied by the owner. The milk was completely serous in the right hind quarter. In two days without forming any clots the liquid secreted became gradually white and soon was normal milk. The gland recuperated and was restored to its former secretory aptitude.

Case 3.—Galactophoritis-grave. Normand cow, 5 years old, calved several weeks before. One hind and one front quarter were affected. Teats were inflamed and later the lower part of the affected quarters became œdematous. The milk contained cheese-like clots suspended in a small quantity of whey. In eight days the milk was normal, but the flow was somewhat lessened.

I think it is possible to interpret these clinical observations. (a) In whatever manner the clots are formed, to observe these particles in case 3 it is necessary that normal milk is secreted by the acini. This milk descends the ducts and flows into the sinus which, one or the other, is in the siege of an inflammation of infectious origin. The liquid collected is also inoculated

XUM

and in all cases, with variable modalities according to the quantity and quality of the microbes, it submits to coagulation and takes on the aspect so well known.

A first point to be remembered is that the white clots are a sign of galactophoritis and the serum indicated that a part of the gland is affected with the infection.

(b) When the liquid milked from the teat is perfectly serous and limpid without clots of milk it is evident that the gland is not secreting milk and points to massive destruction of the gland (case 1). The product milked out does not merit the name " milk," and whatever may be done the function of the gland is definitely lost.

On the other hand, when the liquid milked out is still abundant and soon becomes whitish, it can be said that the glandular cells have been injured but are capable of recuperating and having their secretory aptitude restored.

A second point is that serous liquid tinted rose-coloured is the sign of parenchymatous mastitis.

Such are the perfect or rather schematic types of acute mastitis. As I have indicated, these are exceptional. The average case is a complex of these.

For example, after having collected from an affected quarter milk that is clotted, the fluid that follows contains only a few clots. The case is, therefore, one of galactophoritis complicated with mastitis. In another case the quarter is hard and the liquid milked out contains clots in considerable abundance. The serous fluid comes directly from injured acini and the clots indicate that certain lobes of the gland are not affected and are secreting milk that clots in the ducts and sinus. This hypothesis appears to be confirmed by the fact that the gland, generally, is not completely destroyed after recovering from the inflammation.

Third point, besides, during the initial period, the more abundant the clots are the less serious is the prognosis in so far as the functioning of the gland is concerned.

In fine, we believe that the clinical examination of the secretion often permits one to form an exact idea of the existing disorders in the mammary gland and of the seriousness of the disease itself.

Of course, these principles do not pretend to give the practitioner any assurance outside the domain of biology. But, in the majority of cases observed in recent years, we have had the satisfaction of seeing our prognoses confirmed by these eventualities.

XUM

TULAREMIA*

By O. B. GRAY

Williamsfield, Ill.

A RECENT experience of the writer is reported with the hope that it may serve a useful purpose to other veterinarians. About the middle of July, 1930, I noticed a small pimple on the lateral side of the third finger on my left hand, adjacent to the nail. The inflammation extended from the pimple completely around the edge of the nail, to involve the end of the finger in the course of two or three days. Fever and chills followed, which continued for a week or ten days. The chills appeared only in the evening. On the last day of July my local physician lanced the finger, suggesting that it might be a felon. Local applications of antiseptics were applied daily while the finger was accompanied by a lymphatic involvement, extending along the forearm to the axillary lymph glands. The latter was swollen to the size of a hen's egg and painful. The nodular lymphatics beneath the skin on the forearm and arm were red and mildly sensitive upon palpation for several days.

At the request of my local physician I presented my case on two occasions to a prominent medical clinic. Both times a diagnosis of glanders was made.

While the writer was not impressed with the diagnosis of glanders, it was apparent that there was a lymphatic involvement sufficient to demand attention. Agglutination and complement fixation tests for glanders as well as the agglutination test for tularemia were made. Direct cultures from the aspirated pus as well as the lesion on the finger were also made. On October 12 the left axillary lymph glands suppurated.

The complement fixation and agglutination test for glanders were negative, the former being conducted by the bureau of animal industry as well as the veterinary laboratory of the army medical school, Walter Reed Hospital, Washington, D.C., while agglutination tests for tularemia which proved positive (agglutinating in dilution of 1 : 800) were applied by the animal pathology laboratory at the University of Illinois.

Diagnosis : Tularemia

The writer has not had contact with sheep, rabbits or rodents, and is at a loss to know when or where the infection was contracted. Since tularemia in Illinois is a disease primarily of rabbits, and occurs in hunters or persons handling infected rabbits, it is tentatively presumed that the writer contracted this infection through these animals or possibly through some host not yet recognised. Since sheep are regarded as susceptible, the writer acknowledges treating a sheep some two months before the initial lesions

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appeared, but the illness observed in the sheep was not diagnosed or recognised as tularemia.

Summary

An initial papule about the size of a pin-point on the third finger of the left hand, adjacent to the finger nail, displayed a progressive inflammatory process that finally involved the nail and entire end of the finger. The regional lymph glands became inflamed and swollen two or three weeks later. The left axillary gland suppurated. The involvement of the lymphatics prompted the diagnosis of glanders by prominent medical authorities. Complement fixation and agglutination tests for glanders as well as for tularemia established a diagnosis of tularemia. The writer had no known contact with active tularemia cases.

UNEMPLOYMENT FACES SCIENCE'S WHITE MICE*

By CHARLES F. BERRY

MILLIONS of white mice in America face the problem of unemployment, according to indications of the medical exhibits planned for the Hall of Science at the 1939 Golden Gate International Exposition on San Francisco Bay.

None other than the lowly water flea threatens to replace the mouse in the affections of the laboratory scientist. As a test animal the water flea, or *Daphnia magna,* a transparent water organism of microscopic size, has proven himself so useful as to bid to usurp the occupation which had been handed down through generations of white mice.

Although so small that it is barely visible to the naked eye, the daphnia, a form of crustacean, reacts to drugs and chemicals both quantitatively and qualitatively almost the same as humans or animals. The principal advantage of the daphnia as a test animal is that it is transparent and scientists can watch the actual action of its various organs through a microscope.

The reactions of these tiny creatures to drugs will be shown to the public for the first time at the $50,000,000 World's Fair at San Francisco. Through the use of sound colour film the effect of chemicals and drugs on the living tissues and the internal mechanism of muscles and organs will be made plainly visible. Visitors to the Fair will also be able to watch the reaction of its well-developed nervous and glandular system through a microscope. The action of the heart, respiratory system, liver, stomach, kidneys and other organs can be studied under the administration of therapeutic, toxic, critical and fatal doses of drugs.

The use of daphnia as a test animal is expected to open a new world

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**Australasian Pharmaceutical Notes and News,* September 10, 1938.

of medical experimentation and to aid in the study and evaluation of a great variety of drugs. Through actual observation of the various organs, scientists can watch the effect of various new drugs on the heart. They can follow the action of poisons which put the animal into convulsions, and observe the reaction of antidotes.

Millions of visitors to the Exposition are expected to view these exhibits, which will be arranged by Dr. Arno Viehoever, of the biological and biochemical research laboratories of the Philadelphia College of Pharmacy and Science.

News

THE IVTH INTERNATIONAL CONGRESS OF COMPARATIVE PATHOLOGY

FROM May 15 to 20 the above Congress met in Rome under the Presidency of Professor P. Rondoni. There was a large gathering of scientists from many countries, including Great Britain. The subjects discussed were grouped under four heads—virus diseases, heredity in pathology, function of associated antigens, and regressive changes in plants. The various writers of papers gave a résumé of their articles published in the proceedings and as a rule spoke in the language of the country they represented. The subjects covered a wide range, but the language difficulty detracted somewhat from the immediate value of the meetings and discussions.

Veterinary interests were well represented, for many of the papers and discussions, though not necessarily having a direct bearing on the control of diseases of animals, were of much indirect value to research workers in their general study of disease problems. The section dealing with virus diseases was particularly interesting, embracing much of the latest work of a fundamental nature as well as methods for the prevention of diseases caused by these agents. Papers on the subject were presented by workers from Germany, France, America and Italy. To veterinarians, the paper by Waldmann (Riems) probably held the greatest interest. He gave an account of the results of the use of the vaccine he had prepared for the prevention of foot-and-mouth disease. It transpired, during the discussion, that trials of the same vaccine in some other countries had also yielded satisfactory results.

The papers on heredity in pathology were representative of the views held by workers in different countries. This country was represented by Professor F. A. E. Crew (Edinburgh), who discussed the aspect of diseases of animals from the genetic aspect and held that the study of comparative genetics may be of much help to comparative pathology.

Under the title of function of associated antigens four important papers were submitted, this country being represented by an article by Professor J. Marrack, who dealt with the nature of the combination between antibodies and antigen. A noteworthy paper on the subject was that given by Professor G. Ramon (Paris), who outlined his researches into the production of antitoxins in horses and the use of vaccines of different types at the same time in man.

In addition to the chief papers in the various sections, shorter communications were made by workers from several countries. Here again a certain amount of language difficulty was experienced which detracted somewhat from the full benefit of the work.

In due course the proceedings of the Congress will be published, and it is hoped to abstract some of the most important and interesting articles in this journal.

VISIT OF MINISTER OF AGRICULTURE

Sir Reginald Dorman-Smith and Mr. A. T. A. Dobson, Permanent Secretary, visited the British Cod Liver Oil Producers (Hull), Ltd.'s, Refinery at Marfleet on Wednesday, May 31, and made a detailed inspection of the whole plant, including the Biological Testing Station. Sir Reginald was very much impressed with the efficiency and the care which is taken with modern British cod liver oil production and is fully convinced that cod liver oil is an essential ingredient of livestock foodstuffs. The importance of cod liver oil was dramatically emphasised to the Minister when he inspected a battery of turkeys which were being used for the purpose of testing the food efficiency of " Sol-vit-ax " cod liver oil. Here he saw birds of the same age and from the same pen and fed on the same ration. One batch received " Sol-vit-ax " and the other did not. Two birds were picked out so that Sir Reginald could inspect them. One bird stood upright and the other seemed almost exhausted and could not raise itself above a squatting position. The difference was very striking indeed and was entirely due to the addition of " Sol-vit-ax " cod liver oil—at a level of one pint per cwt.—to the standard ration of the diet of the upright bird.

After the visit, the Minister cryptically summed up the situation by saying that, as a result of his visit, he had now found a link between the two departments—Agriculture and Fisheries—and that link was cod liver oil. The fisherman produce it and the stockbreeders cannot do without it.

Visit of Yorkshire Veterinary Medical Society

Thirty-five members of the above Society also visited the British Cod Liver Oil Producers (Hull), Ltd.'s, Refinery at Marfleet and held their business meeting after a tour of the Refinery and Biological Station. A special paper was read on " Animal Nutrition " by Mr. K. MacLennan, and the importance of cod liver oil in livestock feeding was fully demonstrated.

Legal

POSED AS A VETERINARY SURGEON

For posing as a veterinary surgeon, Leslie Lawrence James Harrison, whose address was given as the Corner House, Stock Lane, Langford, was fined £5 with 28s. 6d. costs, at Long Ashton Police Court on June 2.

He was summoned for describing himself as a horse, cattle and canine specialist to the British Veterinary Association and the Western Veterinary Research Association.

It was alleged that Harrison went to the farm of Mr. B. B. J. Pearce, at Winford and inoculated 25 cattle for 4s. each.

On the bill he presented he described himself as "L. L. J. Harrison, Horse, Cattle and Canine Specialist, late consulting specialist to the British Veterinary Association and the Western Veterinary Research Association."

Letter to College

In a letter to the Veterinary College asking for the proceedings to be withdrawn, he said he was quite prepared to stop using the printed cards and bills complained of.

He admitted he was not a qualified man, but said he was practising in order that he might save up the money to meet the expenses of the five years' training, as he hopes to qualify in due course.

Police Inspector Watts said Harrison had been in the Long Ashton and Glastonbury districts for the past six months.

Reviews

Animal Pathology. By Russell A. Runnells. Collegiate Press Inc., Ames, Iowa. Price $6 net.

The objects of this book are clearly stated in the preface, viz., that it is principally a text for the courses in general and special pathology given in most American veterinary colleges in the second year of the professional curriculum, that it serves as an introduction to the clinical phases of veterinary medicine, and that it should be of interest and value to the veterinarian who wishes to review the fundamentals of animal disease processes or to note the recent advances made in the field of animal pathology.

The book is divided into three parts, general pathology, systematic pathology and special pathology of the specific infectious diseases. The arrangement of the subject matter is concise and as an addendum to many sections is a list of references. Although the book may be intended mainly for American readers it is unfortunate that the author has not seen fit to include in these lists many more references of important articles published in scientific journals other than those produced in America. It may be, of course, that the author has only had access to American literature and to a few British and continental journals; at the same time, however, it would enhance the value of this work if the reader had been referred to some of the outstanding literature, especially from continental sources.

The subject matter makes easy reading and gives the reader quite an accurate account of the pathological processes met with in veterinary practice without having to read through masses of literature to gain a clear conception of the subject on which he desires information. Accepting that the book has this brevity and conciseness as its object, then it can be recommended. If, however, it is to be regarded as a detailed description of the various pathological processes and their relationship to the causes of disease, the student will require to study the literature quoted in the references together with the works of other well-known writers.

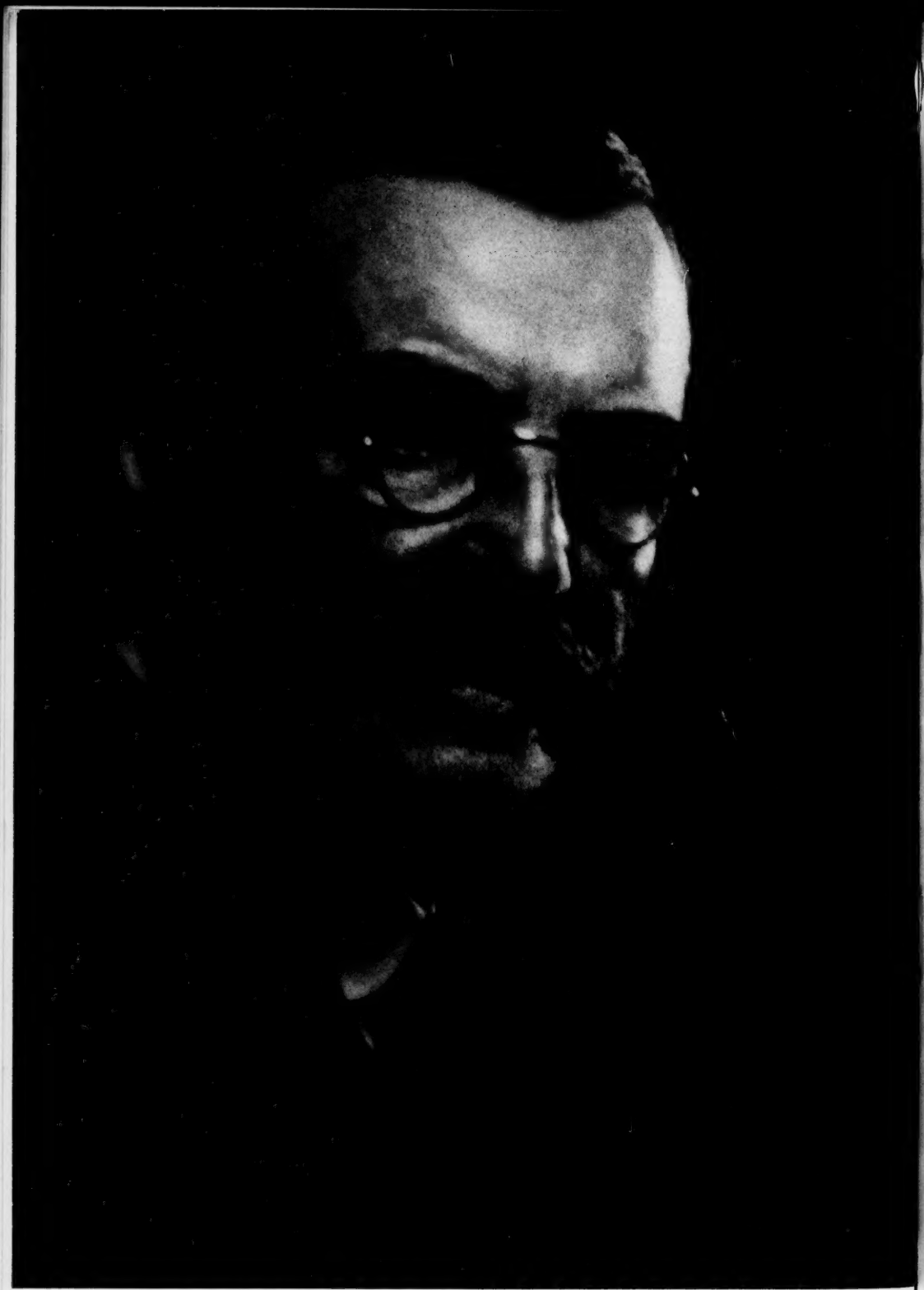
Naturally it is not to be expected that all readers will agree with all the statements made by the author, especially when he is evidently quoting from the writings of others. Had he referred to other works he might have decided to express somewhat different views on some of the diseases he discusses. It may be true, for example, that in America *Alcaligenes bronchisepticum* is an almost constant secondary invader in canine distemper and that pneumonia is common in acute distemper infection; these remarks cannot be applied to the disease in this country.

The general section on tumours (pp. 155-184) gives, in a very concise manner, an account of the common tumours affecting domestic animals in a general way and they are again referred to under the various sections in Part II. This chapter is typical of the system with which the various subjects are dealt—clear, concise and essentials only considered.

The illustrations and photomicrographs are well produced on the whole and usually portray typically the lesions, etc., under consideration. This, unfortunately, cannot be said of all textbooks.

The publishers are to be congratulated on their efforts in presenting the volume in such an agreeable form.

Allowing for the above "detractions" as a textbook for English veterinary students and veterinary surgeons, it will probably be found of considerable value in enabling readers to gain a working knowledge of the subject without excessive reading.



Major Sir Frederick Hobday, C.M.G., F.R.C.V.S., F.R.S.E., Dr. Med. Vet.(Zurich), Hon. Veterinary Surgeon to H.M. the King.